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I, MICHAEL SHEEHAN, EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003903645 for a patent by AARON DAVIDSON and CRAIG COLIN HILL as filed on 11 July 2003.

WITNESS my hand this
Eighteenth day of March 2010

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COMMONWEALTH OF AUSTRALIA
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PROVISIONAL SPECIFICATION FOR THE INVENTION ENTITLED :

EXTRACTING ENERGY FROM FLUIDS

This invention is described in the following statement :-

COMS ID No: SMBI-00337774 Received by IP Australia: Time (H:m) 16:55 Date (Y-M-d) 2003-07-11

Technical Field

This invention relates a method and apparatus for extracting energy from flowing fluids and in particular to an improved method and apparatus for increasing the efficiency of extraction of energy from flowing liquids.

Background Art

It is well known to extract energy from a flowing fluid by the use of suitable turbines which drive electrical generators to generate electricity. Such arrangements are commonly used in hydroelectric systems and usually use a head of water created through the construction of a dam to create a flow of water through conduits in which turbines are positioned. These systems whilst relatively efficient can negatively impact the environment during and following construction of the dams.

Other systems have been proposed and used which use the sea as a source of energy. Energy can be extracted from the sea by using the wave motion of the sea or tidal movement of the sea. A slow moving body of fluid however requires a large and costly prime mover to generate the necessary motion to drive energy extraction means. While the body of fluid may well be capable of providing substantial energy, it is the harnessing of that energy which is difficult. In order to generate an adequate supply of electricity to render a system profitable, a velocity of fluid flow should be high enough to avoid the necessity of providing costly and complicated prime movers. The costs of systems currently proposed or in use are too high to justify their broad implementation. In the various systems which are presently used, it is difficult to obtain a sufficiently high fluid velocity to enable efficient extraction of energy.

Summary of the Invention

The present invention aims to provide an improved method and apparatus for extracting energy from flowing fluid which overcomes or at least alleviates one or more of the above disadvantages. In a particular aspect the present invention aims to provide a diffuser for use in enhancing energy collection from a flow of fluid such as water in a tidal energy extraction system. Other objects and advantages of the invention will become apparent from the following description.

According to one aspect of the present invention, there is provided a diffuser for use in apparatus for extracting energy from a flow of liquid, said diffuser defining a flow passage for fluid, said flow passage having an inlet and an outlet and opposite side walls between said inlet and said outlet, and wherein said side walls comprise a plurality of profiled sections.

Preferably, a gap is provided between a trailing portions of each profiled section and a leading portion of an adjacent profiled section other than at the leading and trailing ends of the diffuser so as to introduce high energy flow from outside of the diffuser to prevent boundary layer separation and recovering velocity head.

Typically, the diffuser may be positioned in a naturally occurring flow of fluid. The conduit means may be supported on a suitable support means positioned in the flow of fluid. Alternatively, the diffuser means may be suspended from a suitable structure or other means such as a buoyant body or anchored at a required elevation within the body of fluid.

Preferably the profiled sections forming the diffuser side walls comprise aerofoil section members. The aerofoil section members preferably comprise asymmetric aerofoil section members.

The diffuser suitably defines a passage which initially decreases in cross sectional area from the inlet to a constricted region between the inlet and the outlet and, thereafter, has an increasing cross sectional area rearwardly and away from the constricted region.

The diffuser suitably includes upper and lower walls and the aerofoil section members suitably comprise elongated members which are oriented substantially vertically and extend between the upper and lower walls of the diffuser.

The aerofoil sectioned members from the constriction rearwardly are angled at an increasing angle to the longitudinal axis of the diffuser with respective openings or gaps formed between the trailing edge of one vent member and the leading edge of the adjacent trailing vent member. In a typical configuration illustrates, the diffuser shroud has aerofoil sectioned members which rearwardly of the constriction angled at 10 degree increments to the longitudinal axis of the diffuser.

At the leading end of the diffuser, opposite aerofoil sectioned members are suitably in the side walls being angled outwardly from the constriction suitably at 10 degrees to the longitudinal axis of the diffuser. Further aerofoil sectioned members at or adjacent the constriction suitably extend substantially parallel to the longitudinal axis of the diffuser.

When applied to use in energy collection apparatus for extracting energy from a flowing liquid, a suitable prime mover indicated is positioned in or near the constriction. The prime mover is configured to be acted upon by the water passing through the diffuser to rotate at a speed proportional to the velocity of the water in the constriction. Typically, the prime mover is in the form of a turbine which has a rotatably mounted shaft and wing-like blades supported on the shaft. The blades may be spaced from, and be parallel to, the shaft

which extends through the top or bottom wall to be coupled if desired through suitable gearing or a suitable transmission to an electrical generator for generation of electricity. The turbine however may be in any suitable configuration which will allow energy to be extracted from the accelerated fluid flow through the constriction.

In order to utilise the energy generated by the rotating prime mover, an electricity generating arrangement may be mounted on the top or bottom walls of the diffuser. The generator can be in the form of any suitable electricity generator and is tailored to suit the application of the apparatus.

The turbine can be mounted either in a vertical orientation or alternatively, can be mounted horizontally, depending on location and constructional requirements.

In use, the diffuser is positioned in a naturally occurring flow of water and such that the inlet is positioned upstream of the outlet.

The prime mover for location in the conduit means may be of any suitable configuration. In one preferred configuration however, the prime mover may be in the form of at least one set of blade members mounted on a shaft. Each blade member may be positioned and configured so that the shaft is rotated when fluid passes through the passage. The blade members of the, or each, set may be oriented to extend between one of the pairs of opposed walls. The shaft and the blade members may be positioned orthogonally with respect to a direction of flow through the conduit means. Thus, an axis of rotation of the shaft and the blade members is orthogonal with respect to the direction of flow.

Each blade member may be mounted on its respective shaft via one or more arms that extend radially from the shaft. Each blade member may be adjustably mounted on its respective arm/s so that the blade members can be adjusted to produce maximum response to the flow of fluid through the conduit means.

The blades of the turbine are suitably mounted so as to be capable of limited pivotal length about their longitudinal axes. Damping means are suitably provided to damp the pivoting movement of the blades.

The blade members and the, or each, shaft may be substantially vertically oriented when the conduit means is in an operative position. Alternatively, the blade members and the, or each, shaft may be substantially horizontally oriented when the conduit means is in an operative position.

The apparatus may include an energy take-off means that is connected to the, or each, shaft. The, or each, energy take-off means may include an electrical generator for generating electricity.

A plurality of prime movers and corresponding generators may be mounted on the conduit means.

The attached drawing illustrate preferred embodiments of the diffuser and associated turbine. It will be appreciated however that the turbine used to extract energy from flow through the diffuser may be in many different configurations other than that shown and described. Similarly, the illustrated turbine may be used with other forms of diffuser or shroud or in other applications.

Fig. 1 is a plan view of a down stream diffuser with a four blade vertical axis turbine. The aerofoil section members which form the side walls of the diffuser are arranged such that gaps are provide between the trailing end of each aerofoil section member and the leading end of an adjacent member so as to introduce high energy flow from outside the duct prevent boundary layer separation and recovering velocity head. The geometry of the profile sections is such that at the inlet, the aerofoil sections are flared out at 10 degrees each or 20 degrees inclusive. The aerofoil sections at the trailing end of the diffuser flare out at 40 degrees each or 80 degrees inclusive. These angles however may be varied both at the trailing and leading end of the diffuser. The aerofoil sectioned members have rearwardly from the constriction an increasing angle to the longitudinal axis of the diffuser. Preferably, the aerofoil sectioned members have a asymmetrical configuration as illustrated.

The turbine suitably includes a vertical axis turbine provided with a plurality of circumferentially spaced vertical blades of aerofoil cross section. Preferably each blade of the turbine is mounted for limited pivotal movement about a longitudinally extending axis. Each blade of the turbine is allowed to pitch to a limited degree in this embodiment + or – 10 degree with movement dampened by means of a hydraulic dampener.

The turbine is located toward the front of the long axis of the diffuser, immediately inside the inlet. The turbine blades are positioned with the concave out as this provides best performance. The turbine shown here has an anti clockwise rotation due to the blade orientation but could be reversed to clockwise by reversing the blades. The turbine can have 3 or more blades.

The blades can be held either by means or radial arms or by solid disks top and bottom so that the disk and the blades rotate.

The pivot axes of the turbine blades must be less than 25% of the chord distance form the leading ends of the blades. The pitching action is damped by means of a hydraulic dampener open to outside water that prevents the turbine blades from excessive shock during the pitching moment that would otherwise destroy the blades and the turbine assembly over time.

On the compression stroke of the piston the piston end prevents the pitch amplitude exceeding 10 degrees and on the suction stroke of the piston the piston arm has a stopper that prevents the movement exceeding 10 degrees in the opposite direction.

Fig. 2 is a plan view of the turbine assembly showing the turbine assembly and the turbine blades as they pitch through an arc of + and – 10 degrees or 20 degrees inclusive. Fig. 3 shows the position of the turbine blades at each position in Fig. 2.

In Figure 3a, the turbine blade is in a neutral position or pitch. Figure 3b shows a – 10 degree pitch position with the pitch movement controlled by the bump stop preventing the piston arm form further movement. Figure 3c shows the + pitch position and the piston end controlling the blade pitch. Figure 3d shows the neutral pitch position opposite the Figure a position.

It will of course be realised that the above has been given only by way of illustrative example of the invention and that all such modifications and variations thereto as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of the invention as is herein defined.

Dated this eleventh day of July 2003

Aaron DAVIDSON
Craig Colin HILL
By Their Patent Attorney

JOHN R.G. GARDNER

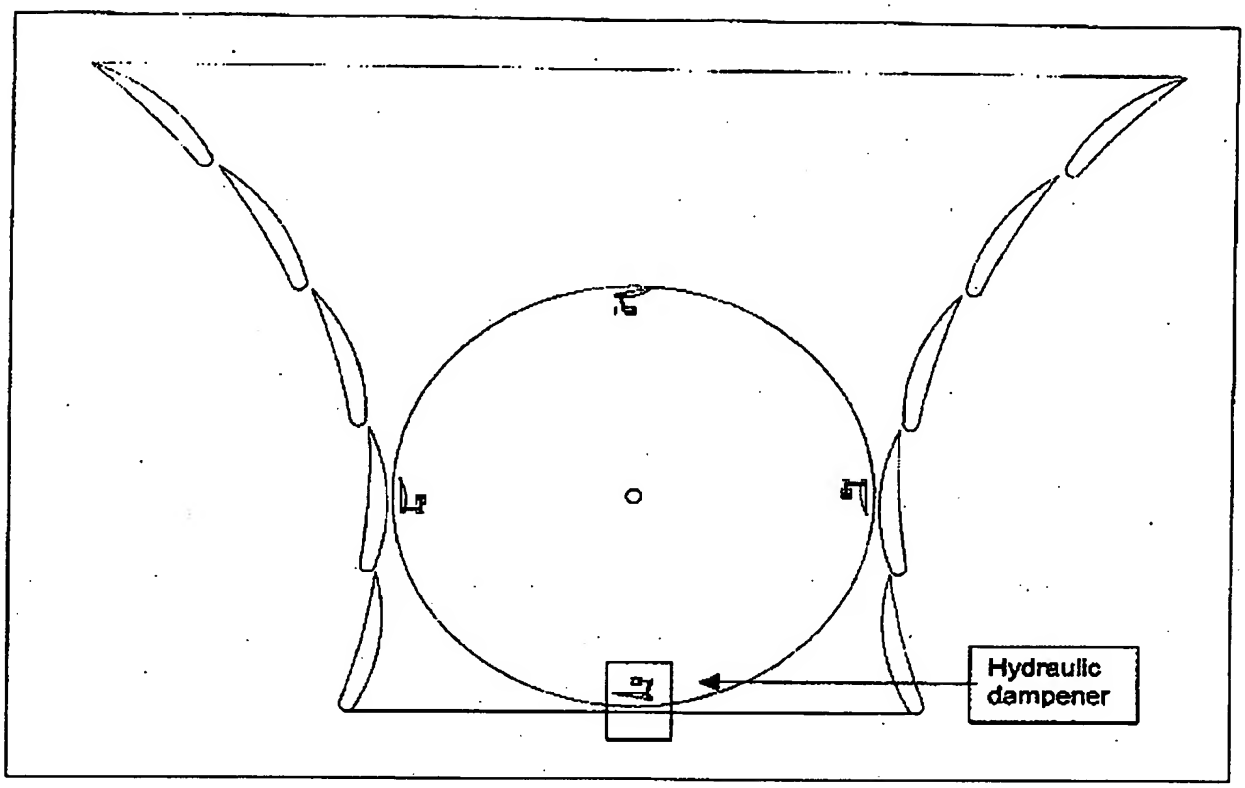

FIG. 1

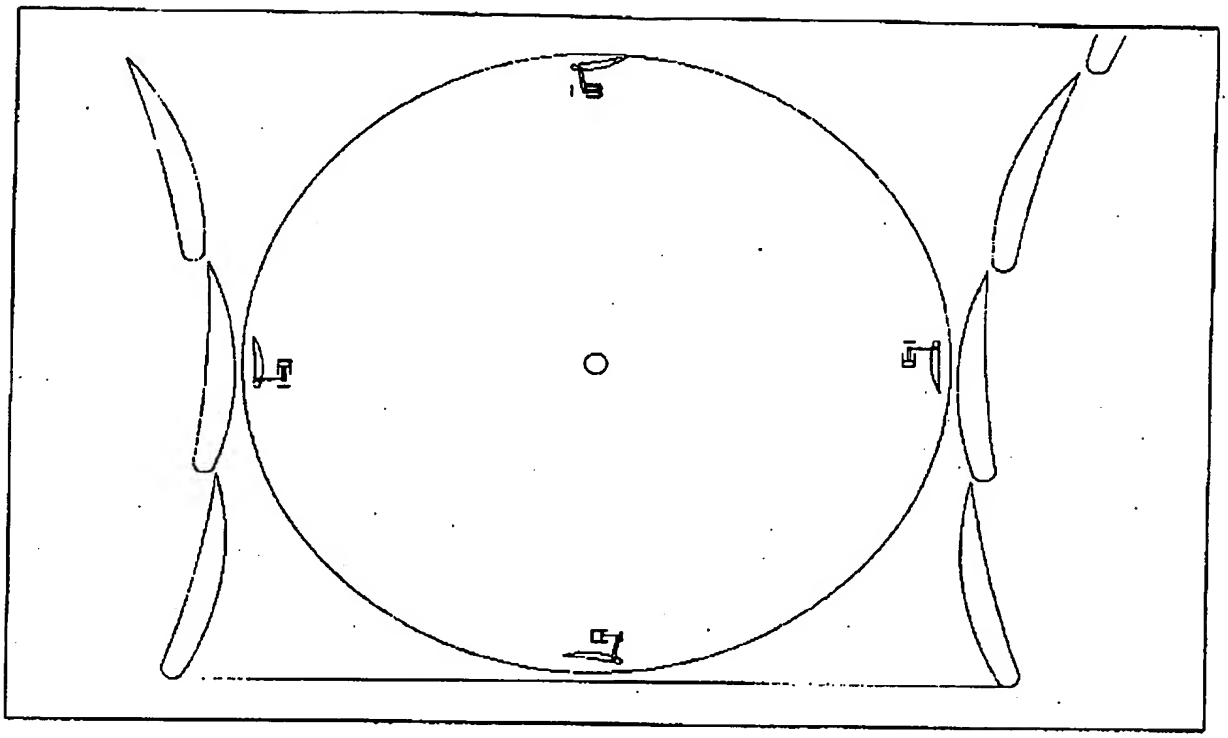

FIG. 2

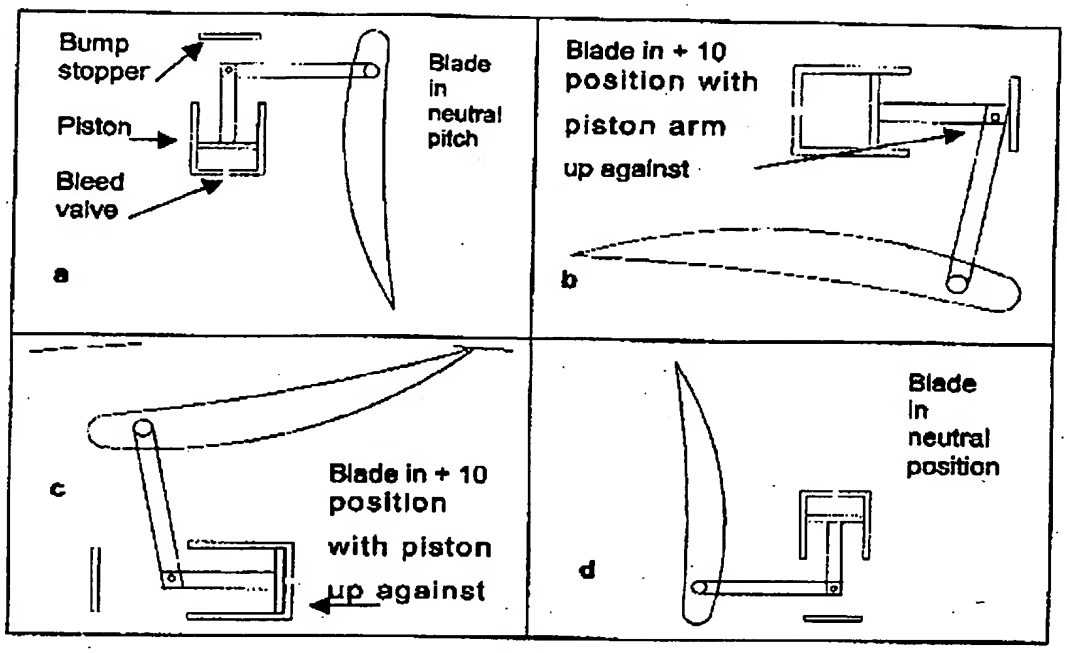
Bump stopper
Piston
Bleed valve
a
Blade in neutral pitch
Blade in + 10 position with piston arm up against
b
c
Blade in + 10 position with piston up against
d
Blade in neutral position

FIG. 3